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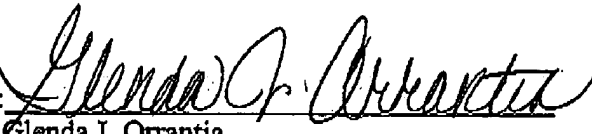
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PAGES 98VOICE NO. 214.953.6559  
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RETURN TO Glenda Orrantia  
ParalegalTO Examiner Wilbert Starks  
Art Unit 2121FAX NO. 703-746-7240  
VOICE NO. 571-272-3691**MESSAGE**In re Application of: Mark D. Levedahl  
Serial No.: 10/086,988  
Filed: February 28, 2002  
Group No.: 2121  
Confirmation No.: 6322  
Title: METHOD AND SYSTEM FOR ASSIGNING OBSERVATIONS

Attorney Docket No.: 064749.0141

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I hereby certify that this cover sheet and the attached documents are a true and correct copy of all documents received and filed with the U.S. Patent and Trademark Office after the initial filing date of the above-identified application and that the foregoing is being transmitted by facsimile to the United States Patent and Trademark Office on the date shown below.

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Date: March 1, 2005

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/086,988	02/28/2002	Mark P. ClevGahl	064749.0141 (PD 02E002)	6322
5073	7590	03/26/2004	EXAMINER	
BAKER BOTTS L.L.P. 2001 ROSS AVENUE SUITE 600 DALLAS, TX 75201-2980			STARKS, WILBERT L	
			ART UNIT	PAPER NUMBER
			2121	5
DATE MAILED: 03/26/2004				

DOCKET

*Amendment Due:  
June 26, 2004*

Please find below and/or attached an Office communication concerning this application or proceeding.

Docket ☒ Wrapper ☒  
 R/C Docketed ☒ N/A  
 Pre-examination ☒

PTO-90C (Rev. 10/03)

**Office Action Summary**

Application No.

10/088,988

Applicant(s)

LEVEDAHL, MARK D.

Examiner

Wilbert L. Starks, Jr.

Art Unit

2121

— The MAILING DATE of this communication appears on the cover sheet with the correspondence address —  
 Period for Reply

**A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.**

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 28 February 2002.  
 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.  
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-40 is/are pending in the application.  
 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
 6) ☒ Claim(s) 1-40 is/are rejected.  
 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.  
 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) ☐ All b) ☐ Some \* c) ☐ None of:  
 1. ☐ Certified copies of the priority documents have been received.  
 2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)  
 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-848)  
 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
 Paper No(s)/Mail Date \_\_\_\_\_  
 4) ☐ Interview Summary (PTO-413)  
 Paper No(s)/Mail Date \_\_\_\_\_  
 5) ☐ Notice of Informal Patent Application (PTO-152)  
 6) ☐ Other: \_\_\_\_\_

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**DETAILED ACTION*****Claim Rejections - 35 USC § 101***

1. 35 U.S.C. §101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

the invention as disclosed in claims 1-40 is directed to non-statutory subject matter.

2. Regardless of whether any of the claims are in the technological arts, none of them is limited to practical applications in the technological arts. Examiner finds that *In re Warmerdam*, 33 F.3d 1354, 31 USPQ2d 1754 (Fed. Cir. 1994) controls the 35 USC §101 issues on that point for reasons made clear by the Federal Circuit in *AT&T Corp. v. Excel Communications, Inc.*, 50 USPQ2d 1447 (Fed. Cir. 1999). Specifically, the Federal Circuit held that the act of:

...[T]aking several abstract ideas and manipulating them together adds nothing to the basic equation. *AT&T v. Excel* at 1453 quoting *In re Warmerdam*, 33 F.3d 1354, 1360 (Fed. Cir. 1994).

Examiner finds that Applicant's "observation" references are just such abstract ideas.

3. Examiner bases his position upon guidance provided by the Federal Circuit in *In re Warmerdam*, as interpreted by *AT&T v. Excel*. This set of precedents is within the same line of cases as the *Alappat-State Street Bank* decisions and is in complete

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agreement with those decisions. *Warmerdam* is consistent with *State Street*'s holding that:

*Today we hold that the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation because it produces 'a useful, concrete and tangible result' — a final share price momentarily fixed for recording purposes and even accepted and relied upon by regulatory authorities and in subsequent trades. (emphasis added) State Street Bank at 1601.*

4. True enough, that case later eliminated the "business method exception" in order to show that business methods were not per se nonstatutory, but the court clearly *did not* go so far as to make business methods *per se* statutory. A plain reading of the excerpt above shows that the Court was *very specific* in its definition of the new *practical application*. It would have been much easier for the court to say that "business methods were per se statutory" than it was to define the practical application in the case as "...the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price..."

5. The court was being very specific.

6. Additionally, the court was also careful to specify that the "useful, concrete and tangible result" it found was "a final share price momentarily fixed for recording purposes and even accepted and relied upon by regulatory authorities and in subsequent trades." (i.e. the trading activity is the further practical use of the real world

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monetary data beyond the transformation in the computer – i.e., “post-processing activity”.)

7. Applicant cites no such specific results to define a useful, concrete and tangible result. Neither does Applicant specify the associated practical application with the kind of specificity the Federal Circuit used.

8. Furthermore, in the case *In re Warmerdam*, the Federal Circuit held that:

... [T]he dispositive issue for assessing compliance with Section 101 in this case is whether the claim is for a process that goes beyond simply manipulating 'abstract ideas' or 'natural phenomena' ... As the Supreme Court has made clear, '[a]n idea of itself is not patentable, ... taking several abstract ideas and manipulating them together adds nothing to the basic equation.' *In re Warmerdam* 31 USPQ2d at 1759 (emphasis added).

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9. Since the Federal Circuit held in *Warmerdam* that this is the "dispositive issue" when it judged the usefulness, concreteness, and tangibility of the claim limitations in that case, Examiner in the present case views this holding as the dispositive issue for determining whether a claim is "useful, concrete, and tangible" in similar cases. Accordingly, the Examiner finds that Applicant manipulated a set of abstract "observations" to solve purely algorithmic problems in the abstract (i.e., what *kind* of "observations" are used? Algebraic word problems? Boolean logic problems? Fuzzy logic algorithms? Probabilistic word problems? Philosophical ideas? Even vague expressions, about which even reasonable persons could differ as to their meaning? Combinations thereof?) Clearly, a claim for manipulation of "observations" is provably even more abstract (and thereby less limited in practical application) than pure "mathematical algorithms" which the Supreme Court has held are per se nonstatutory – in fact, it *includes* the expression of nonstatutory mathematical algorithms.

10. Since the claims are not limited to exclude such abstractions, the broadest reasonable interpretation of the claim limitations includes such abstractions. Therefore, the claims are impermissibly abstract under 35 U.S.C. 101 doctrine.

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11. Since *Warmerdam* is within the *Alappat-State Street Bank* line of cases, it takes the same view of "useful, concrete, and tangible" the Federal Circuit applied in *State Street Bank*. Therefore, under *State Street Bank*, this could not be a "useful, concrete and tangible result". There is only manipulation of abstract ideas.

12. The Federal Circuit validated the use of *Warmerdam* in its more recent *AT&T Corp. v. Excel Communications, Inc.* decision. The Court reminded us that:

Finally, the decision in *In re Warmerdam*, 33 F.3d 1354, 31 USPQ2d 1754 (Fed. Cir. 1994) is not to the contrary. \*\*\* The court found that the claimed process did nothing more than manipulate basic mathematical constructs and concluded that 'taking several abstract ideas and manipulating them together adds nothing to the basic equation'; hence, the court held that the claims were properly rejected under §101 ... Whether one agrees with the court's conclusion on the facts, the holding of the case is a straightforward application of the basic principle that mere laws of nature, natural phenomena, and abstract ideas are not within the categories of inventions or discoveries that may be patented under §101. (emphasis added) *AT&T Corp. v. Excel Communications, Inc.*, 50 USPQ2d 1447, 1453 (Fed. Cir. 1999).

13. Remember that in *In re Warmerdam*, the Court said that this was the dispositive issue to be considered. In the *AT&T* decision cited above, the Court reaffirms that this is the issue for assessing the "useful, concrete, and tangible" nature of a set of claims under 101 doctrine. Accordingly, Examiner views the *Warmerdam* holding as the dispositive issue in this analogous case.

14. The fact that the invention is merely the manipulation of *abstract ideas* is clear. The data referred to by Applicant's phrase "information as natural language" is simply an abstract construct that does not limit the claims to the transformation of real world data (such as monetary data or heart rhythm data) by some disclosed process.

Consequently, the necessary conclusion under *AT&T*, *State Street* and *Warmerdam*, is

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straightforward and clear. The claims take several abstract ideas (i.e., "information as natural language" in the abstract) and manipulate them together adding nothing to the basic equation. Claims 1-22 are, thereby, rejected under 35 U.S.C. 101.

15. Regarding the "system" recitals in claims 22 – 40, the invention is still found to be nonstatutory. Any other finding would be at variance with current case law. Specifically, the Federal Circuit held in *AT&T v. Excel*, 50 USPQ2d 1447 (Fed. Cir. 1999) that:

Whether stated implicitly or explicitly, we consider the scope of Section 101 to be the same regardless of the form – machine or process – in which a particular claim is drafted. *AT&T v. Excel*, 50 USPQ2d 1447, 1452 citing *In re Alappat*, 33 F.3d at 1581, 31 USPQ2d at 1589 (Rader, J., concurring) (emphasis added.)

16. Examiner considers the scope of Section 101 to be the same regardless of whether Applicant *claims* a "process", "machine", or "product of manufacture". While the "system" recitals in the preambles of claims 22 – 40 make the claims ostensibly drawn to be "apparatus" claims, they are insufficient by themselves to limit the claims to statutory subject matter. Examiner's position is clearly consistent with *Alappat*, and *AT&T* and is implicitly consistent with *Warmerdam* and *State Street*. Accordingly, those claims are also properly rejected.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the

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art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-40 are rejected under 35 USC 112, first paragraph because current case law (and accordingly, the MPEP) require such a rejection if a 101 rejection is given because when Applicant has not in-fact disclosed the practical application for the invention, as a matter of law there is no way Applicant could have disclosed *how* to practice the *undisclosed* practical application. This is how the MPEP puts it:

("The how to use prong of section 112 incorporates as a matter of law the requirement of 35 U.S.C. 101 that the specification disclose as a matter of fact a practical utility for the invention.... If the application fails as a matter of fact to satisfy 35 U.S.C. § 101, then the application also fails as a matter of law to enable one of ordinary skill in the art to use the invention under 35 U.S.C. § 112."); In re Kirk, 376 F.2d 936, 942, 153 USPQ 48, 53 (CCPA 1967) ("Necessarily, compliance with § 112 requires a description of how to use presently useful inventions, otherwise an applicant would anomalously be required to teach how to use a useless invention."). See, MPEP 2107.01(IV), quoting In re Kirk (emphasis added).

Therefore, claims 1-40 are rejected on this basis.

### **Conclusion**

17. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- A. Cho et al (U.S. Patent Number 6,480,991 B1; dated 12 November 2002; class 716; subclass 008) discloses timing-driven global placement based on geometry-aware timing budgets.

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- B. Floratos et al (U.S. Patent Number 6,092,065; dated 18 July 2000; class 707; subclass 006) discloses method and apparatus for discovery, clustering and classification of patterns in 1-dimensional event streams.
- C. Ashar et al (U.S. Patent Number 5,522,063; dated 28 May 1996; class 716; subclass 004) discloses method of finding minimum-cost feedback-vertex sets for a graph for partial scan testing without exhaustive cycle enumeration.

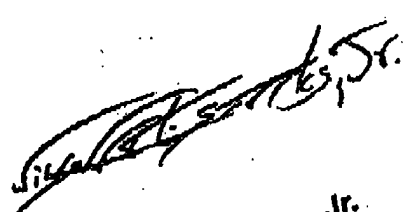
Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Wilbert L. Starks, Jr. whose telephone number is (703) 305-0027.

Alternatively, inquiries may be directed to the following:

S. P. E. Anil Khatri	(703) 305-0282
After-final (FAX)	(703) 746-7238
Official (FAX)	(703) 746-7239
Non-Official/Draft (FAX)	(703) 746-7240

WLS

21 March 2004



Wilbert L. Starks, Jr.  
Primary Examiner  
Art Unit - 2121

**Notice of References Cited**

Application/Control No.

10/086,988

Applicant(s)/Patent Under  
Reexamination  
LEVEDAHL, MARK D.

Examiner

Wilbert L. Starks, Jr.

Art Unit

2121

Page 1 of 1

**U.S. PATENT DOCUMENTS**

*	Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
A	US-6,480,991 B1	11-2002	Cho et al.	718/8
B	US-6,092,065	07-2000	Floratos et al.	707/6
C	US-5,522,063	05-1996	Ashar et al.	718/4
D	US-			
E	US-			
F	US-			
G	US-			
H	US-			
I	US-			
J	US-			
K	US-			
L	US-			
M	US-			

**FOREIGN PATENT DOCUMENTS**

*	Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
N					
O					
P					
Q					
R					
S					
T					

**NON-PATENT DOCUMENTS**

*	Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
U	
V	
W	
X	

\*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)  
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

U.S. Patent and Trademark Office  
PTO-892 (Rev. 01-2001)

Notice of References Cited

Part of Paper No. 5

064749.0141

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Date: 6/19/03

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DALLAS TX 75201-2980

To: Applicant of Serial Number 10086988

We project that this application will be first examined in 12 to 15  
months from today.

Customer Service Office in Technology Center: 09534

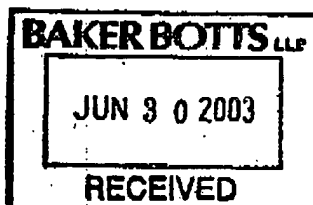
Phone Number: 703-306-5631

FAX Number: 703-746-7240

Applicant/Attorney Contact Information:

Telephone: (214)953-6500

Fax: No Fax #

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RVF Docketed \_\_\_\_\_

Reference(s) \_\_\_\_\_



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Title 37, Code of Federal Regulations, 5.11 & 5.15**

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APPLICATION NUMBER	FILING DATE	GRP ART UNIT	FL FEE REC'D	ATTY. DOCKET NO	DRAWINGS	TOT CLAIMS	IND CLAIMS
10/086,988	02/28/2002	2182	0.00	084749.0141 (PD 02E002)	9	40	4

05073  
BAKER BOTTS LLP.  
2001 ROSS AVENUE  
SUITE 800  
DALLAS, TX 75201-2980

## DOCKETED

CONFIRMATION NO. 6322

### FILING RECEIPT



\*0000000007768027\*

Date Mailed: 04/02/2002

Receipt is acknowledged of this nonprovisional Patent Application. It will be considered in its order and you will be notified as to the results of the examination. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Customer Service Center. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).

#### Applicant(s)

Mark D. Levedahl, McLean, VA;

#### Domestic Priority data as claimed by applicant

#### Foreign Applications

If Required, Foreign Filing License Granted 04/02/2002

Projected Publication Date: Request for Non-Publication Acknowledged

Non-Publication Request: Yes

Early Publication Request: No

#### Title

Method and system for assigning observations

#### Preliminary Class

713

Docket ☒ Wrapper ☒

SVF Docketed ☒ *lys*

Reference(s) *A/H*

**LICENSE FOR FOREIGN FILING UNDER  
Title 35, United States Code, Section 184  
Title 37, Code of Federal Regulations, 5.11 & 5.15**

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The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Office of Export Administration, Department of Commerce (15 CFR 370.10 (j)); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

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APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
10/086,988	02/28/2002	Mark D. Levedahl	064749.0141 (PD 02E002)

 05073  
 BAKER BOTTS L.L.P.  
 2001 ROSS AVENUE  
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 DALLAS, TX 75201-2980

*Filing Fee, Date and  
 Assignment Due:  
 June 2, 2002*

CONFIRMATION NO. 6322

FORMALITIES LETTER



\*0C000000007768028\*

Date Mailed: 04/02/2002

**NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION**

FILED UNDER 37 CFR 1.53(b)

**Filing Date Granted**

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.  
*Applicant must submit \$ 740 to complete the basic filing fee for a non-small entity. If appropriate, applicant may make a written assertion of entitlement to small entity status and pay the small entity filing fee (37 CFR 1.27).*
- Total additional claim fee(s) for this application is \$444.
  - \$360 for 20 total claims over 20.
  - \$84 for 1 independent claims over 3.
- The oath or declaration is unsigned.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(f) of \$130 for a non-small entity, must be submitted with the missing items identified in this letter.
- The balance due by applicant is \$ 1314.

*A copy of this notice **MUST** be returned with the reply.*

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FROM Glenda Orrantia  
DATE October 14, 2004  
PAGES 19

VOICE NO. 214.953.6559  
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Legal Assistant

TO Examiner Wilbert L. Starks  
Art Unit 2121  
U.S. Patent and Trademark Office

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**MESSAGE**

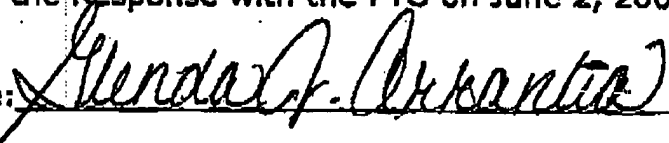
In re Application of: Mark D. Levedahl  
Serial No.: 10/086,988  
Filed: February 28, 2002  
Group No.: 2121  
Title: Method and System for Assigning Observations  
Attorney Docket No.: 064749.0141

**PLEASE DELIVER IMMEDIATELY TO EXAMINER WILBERT STARK**

Examiner Stark:

Pursuant to your voice message, please find attached a true and correct copy of our Response Pursuant to 37 C.F.R. § 1.111, which was filed in connection with your Office Action mailed March 26, 2004. Also attached is a copy of our return postcard which acknowledges receipt of the Response with the PTO on June 2, 2004.

Signature:



Date: October 14, 2004

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Mark D. Levendahl  
Serial No.: 10/086,988  
Filing Date: February 28, 2002  
Examiner: Wilbur L. Starks  
Group No.: 2121  
Confirmation No.: 6322

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Title: METHOD AND SYSTEM FOR ASSIGNING  
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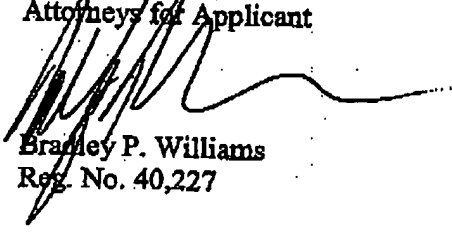
Dear Sir:

**LETTER TO THE EXAMINER**

On November 23, 2004, Glenda Orrantia, a legal assistant with my firm, telephoned Examiner Starks regarding the Response to the Office Action mailed March 26, 2004. Ms. Orrantia informed Examiner Starks that a Response to the Office Action had been mailed via Express Mail on June 2, 2004 and that Examiner Starks had left a voice message with Ms. Orrantia on October 14, 2004 requesting that a copy of the Response be sent via facsimile to him. Attached to this letter is a true and correct copy of the Response Pursuant to 37 C.F.R. § 1.111 mailed on June 2, 2004, including a copy of the acknowledgement postcard indicating receipt of the Response with the U.S. Patent and Trademark Office ("USPTO") on June 2, 2004. Also attached is a copy of the facsimile transmittal dated October 14, 2004 and the Auto-Reply Facsimile Transmission received from the USPTO indicating receipt of the October 14, 2004 facsimile. Accordingly, Applicant is submitting this letter as a confirmation of the above-referenced conversation.

Respectfully submitted,

BAKER BOYTS L.L.P.  
Attorneys for Applicant

  
Bradley P. Williams  
Reg. No. 40,227

Date: 11/23/04  
Customer No. 45507

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PATENT APPLICATION  
10/086,988

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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MAR 01 2005

In re Application of: Mark D. Levedahl  
Serial No.: 10/086,988  
Filing Date: February 28, 2002  
Group Art Unit: 2121  
Examiner: Wilbert L. Starks  
Title: METHOD AND SYSTEM FOR ASSIGNING  
OBSERVATIONS

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

RESPONSE PURSUANT TO 37 C.F.R. § 1.111

In response to the Office Action mailed March 26, 2004, Applicant respectfully requests the Examiner to reconsider the rejection of the claims in view of the following amendments and remarks. Please amend the Application as follows:

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064749.0141

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### IN THE CLAIMS

For the convenience of the Examiner, all pending claims of the present Application are shown below in numerical order whether or not an amendment has been made and applying the revised format guidelines of 37 C.F.R. 1.121.

1. (Currently Amended) A computerized method for assigning observations comprising:

receiving a plurality of first observations indicative of respective physical parameters positions observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters positions observed by a second sensor system;

assigning, by a computer, a set of pairs of the first and second observations predicted to correspond to the same physical parameter position, the assigning comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

2. (Original) The method of Claim 1, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

3. (Original) The method of Claim 1, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

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4. (Original) The method of Claim 1, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

5. (Previously Presented) The method of Claim 1, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^M \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i}{g} + \ln \|S_i\| - \ln(d_{min}) \right\} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} + \begin{matrix} \ln \left( \frac{(2\pi)^{n_a} |R|}{0} \right) & n_a = 0 \\ 0 & n_a > 0 \end{matrix}$$

wherein

- $J_i$  = Assignment score
- $\bar{x}$  = Estimate of relative bias
- $R$  = Relative registration covariance matrix
- $\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$
- $S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$
- $d_{min}$  = Minimum determinant of a residual error matrix
- $g$  = Gate value
- $M$  = Number of first observations
- $n_a$  = Number of non-zero entries in  $a$
- $a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$
- $A_i$  = The plurality of first observations
- $B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

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6. (Original) The method of Claim 5, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.
7. (Original) The method of Claim 5, wherein the relative bias,  $\bar{x}$ , of the cost function is a functional bias.
8. (Original) The method of Claim 1, wherein assigning, by a computer, comprises assigning by a processor operable to execute a computer program stored on a computer readable medium.
9. (Original) The method of Claim 1, wherein assigning, by a computer, comprises assigning by an application specific integrated circuit.
10. (Original) The method of Claim 1, wherein assigning, by a computer, comprises assigning by a digital signal processor.

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11. (Currently Amended) A computerized method for determining the Nbest observation assignments comprising:

receiving a plurality of first observations indicative of respective physical parameters positions observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters positions observed by a second sensor system;

determining, by a computer, one or more sets of pairs of the first and second observations predicted to correspond to the same physical parameter position, the determining comprising:

receiving a cost function that specifies a cost for each assigned pair;

determining a set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of corresponding first and second observations; and

repeating the determining act until a desired number of best observation assignments is determined.

12. (Original) The method of Claim 11, wherein the cost specified by the cost function for each assigned pair is not independent of the assignment of any other assigned pairs in the respective set of assigned pairs.

13. (Original) The method of Claim 11, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

14. (Original) The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

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15. (Original) The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

16. (Previously Presented) The method of Claim 11, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^G \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i + \ln \|S_i\| - \ln(d_{\min})}{g} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \begin{cases} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_i$  = Assignment score

$\bar{x}$  = Estimate of relative bias

$R$  = Relative registration covariance matrix

$\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$

$S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$

$d_{\min}$  = Minimum determinant of a residual error matrix

$g$  = Gate value

$M$  = Number of first observations

$n_a$  = Number of non-zero entries in  $a$

$a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$

$A_i$  = The plurality of first observations

$B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

17. (Original) The method of Claim 16, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.

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18. (Original) The method of Claim 16, wherein the relative bias,  $\bar{x}$ , of the cost function is a functional bias.

19. (Original) The method of Claim 11, wherein assigning, by a computer, comprises assigning by a processor operable to execute a computer program stored on a computer readable medium.

20. (Original) The method of Claim 11, wherein assigning, by a computer, comprises assigning by an application specific integrated circuit.

21. (Original) The method of Claim 11, wherein assigning, by a computer, comprises assigning by a digital signal processor.

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22. (Currently Amended) A system for assigning observations comprising: a computer readable medium; and

a computer program stored on the computer readable medium, the computer program operable, when executed on a processor, to:

receive a plurality of first observations indicative of respective physical parameters positions observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters positions observed by a second sensor system;

assign a set of pairs of the first and second observations predicted to correspond to the same physical parameter position, the assignment comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

23. (Original) The system of Claim 22, and further comprising a processor operable to execute the computer program.

24. (Original) The system of Claim 22, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

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25. (Original) The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

26. (Original) The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

27. (Previously Presented) The system of Claim 22, wherein the cost function is

$$J_i - \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^I \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i + \ln \|S_i\| - \ln(d_{\min})}{\bar{g}} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \begin{cases} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_i$  = Assignment score  
 $\bar{x}$  = Estimate of relative bias

$R$  = Relative registration covariance matrix

$\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$

$S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$

$d_{\min}$  = Minimum determinant of a residual error matrix

$\bar{g}$  = Gate value

$M$  = Number of first observations

$n_a$  = Number of non-zero entries in  $a$

$a$  = Assignment vector:  $a_{(i)} \geq 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$

$A_i$  = The plurality of first observations

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$B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

28. (Original) The system of Claim 27, wherein the relative bias,  $x$ , of the cost function is a simple bias.

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29. (Currently Amended) A system for assigning observations comprising: a computer operable to receive a plurality of first observations indicative of respective physical ~~parameters~~ positions observed by a first sensor system and receiving a plurality of second observations indicative of respective physical ~~parameters~~ positions observed by a second sensor system; and

wherein the computer is further operable to assign a set of pairs of the first and second observations predicted to correspond to the same physical ~~parameter~~ position, the assignment comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

30. (Original) The system of Claim 29, wherein the computer comprising an application specific integrated circuit.

31. (Original) The system of Claim 29, wherein the computer comprises a processor operable to execute a computer program stored on the computer readable medium.

32. (Original). The system of Claim 29, wherein the computer further comprises the computer readable medium.

33. (Original). The system of Claim 29, wherein the computer comprises a digital signal processor.

34. (Original) The system of Claim 29, wherein the computer comprises a field programmable gate array.

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35. (Original) The system of Claim 29, wherein the computer comprises a means for computing.

36. (Original) The system of Claim 29, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

37. (Original) The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

38. (Original) The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

39. (Previously Presented) The system of Claim 26, wherein the cost function is

$$J_s = \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^I \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i + \ln \|S_i\| - \ln(d_{\min})}{\bar{g}} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \begin{cases} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_s$  = Assignment score

$\bar{x}$  = Estimate of relative bias

$R$  = Relative registration covariance matrix

$\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$

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$S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$

$d_{min}$  = Minimum determinant of a residual error matrix

$g$  = Gate value

$M$  = Number of first observations

$n_a$  = Number of non-zero entries in  $a$

$a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$

$A_i$  = The plurality of first observations

$B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

40. (Original) The system of Claim 39, wherein the relative bias,  $x$ , of the cost function is a simple bias.

ATTORNEY DOCKET NO.  
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PATENT APPLICATION  
10/086,988

14

### REMARKS

Applicant thanks the Examiner for conducting the telephone interview on June 1, 2004, and for the Examiner's thoughtful consideration of this case. During the telephone interview, Applicant and Examiner discussed the Examiner's rejection of Applicant's claims under 35 U.S.C. § 101. Specifically, Applicant and Examiner discussed alternative claim language, which is included among the claim amendments to Claims 1, 11, 22, and 29. No new matter has been introduced by these amendments. Applicant does not admit that these amendments were made as a result of any cited art. Applicant understands that all of the pending claims, as recited in this Response to Office Action, are patentable under 35 U.S.C. § 101. Applicant respectfully requests reconsideration and favorable action in this case.

### Rejections under 35 U.S.C. § 101

The Examiner rejects Claims 1-40 under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Specifically, the Examiner found that Applicant's "observation" references are abstract ideas. (Office Action, page 2). In the telephone interview conducted on June 1, 2004, Applicant and Examiner discussed the Examiner's rejection of Applicant's claims under § 101. Although Applicant believes that all previously pending claims recite statutory subject matter under § 101, to advance this case expeditiously to issuance, Applicant has amended independent Claims 1, 11, 22, and 29 to address the issues identified by the Examiner. For at least these reasons, Applicant understands that all of the pending claims, as recited in this Response to Office Action, recite statutory subject matter within the meaning of § 101.

Additionally, in the Office Action, the Examiner states that the "data referred to by Applicant's phrase 'information as natural language' is simply an abstract construct that does not limit the claims to the transformation of real world data (such as monetary data or heart rhythm data) by some disclosed process." (Office Action, page 6). In the telephone interview, the Examiner acknowledged that the phrase "information as natural language" is not recited in any of Applicant's pending claims and that the rejection of Applicant's claims as described in paragraph 14 of the Office Action was made in error. It is Applicant's understanding that the rejection of the claims described in paragraph 14 of the Office Action is withdrawn.

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PATENT APPLICATION  
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Applicant respectfully requests that the rejection of the Claims 1-40 under § 101 be withdrawn and the claims allowed.

**Rejections under 35 U.S.C. § 112**

The Examiner rejects Claims 1-40 under 35 U.S.C. § 112, first paragraph. Specifically, the Examiner states that "current case law (and accordingly, the MPEP) require such a rejection if a 101 rejection is given because . . . as a matter of law there is no way Applicant could have disclosed how to practice the *undisclosed* practical application." (Office Action, page 8). As discussed above, Applicant has amended independent Claims 1, 11, 22, and 29 to address the § 101 issues identified by the Examiner. Accordingly, the basis for the Examiner's § 112 rejection of Claims 1-40 has been removed. Furthermore, in the telephone interview conducted on June 1, 2004, the Examiner indicated that the pending claims, as recited in this Response to Office Action, are patentable under § 101 and § 112. For at least these reasons, Applicant respectfully requests that the rejection of the Claims 1-40 under § 112 be withdrawn and the claims allowed.

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### CONCLUSION

Applicant has made an earnest attempt to place this case in condition for allowance. For the foregoing reasons, and for other reasons clearly apparent, Applicant respectfully requests full allowance of all pending Claims.

If the Examiner feels that a telephone conference or an interview would advance prosecution of this Application in any manner, the undersigned attorney for Applicant stands ready to conduct such a conference at the convenience of the Examiner.

Applicant believes no fees are due. However, the Commissioner is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 02-0384 of Baker Botts L.L.P.

Respectfully submitted,

BAKER BOTTS L.L.P.  
Attorneys for Applicant



Bradley P. Williams  
Reg. No. 40,227

Date: June 2, 2004

Correspondence Address:  
2001 Ross Avenue, Suite 600  
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(214) 953-6447

Customer No.

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PATENT APPLICATION  
10/086,988

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Mark D. Levedahl  
Serial No.: 10/086,988  
Filing Date: February 28, 2002  
Group Art Unit: 2121  
Examiner: Wilbert L. Starks  
Title: METHOD AND SYSTEM FOR ASSIGNING  
OBSERVATIONS

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Dear Sir:

**CERTIFICATE OF MAILING BY EXPRESS MAIL**

I hereby certify that the attached Response Pursuant to 37 C.F.R. § 1.111 (16 pages), Baker Botts return postcard (1 postcard), and this Certificate of Mailing are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on this 2nd day of June 2004 and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.


*Willie Jiles*  
\_\_\_\_\_  
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<input checked="" type="checkbox"/> Amendment/Response	<u>16</u>		

Name of Inventor(s): <u>Mark D. Levendahl</u>		Receipt Date & Serial No:	
Title of Invention: <u>m/s for Assigning Observations</u>			
Client or Applicant: <u>Keytron</u>	US File No.: <u>06/474,014</u>		
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 DATE October 14, 2004  
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VOICE NO. 214.953.6559  
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 Legal Assistant

TO Examiner Wilbert L. Starks  
 Art Unit 2121  
 U.S. Patent and Trademark Office

FAX NO. 703-872-9306  
 VOICE NO. 703-305-0027

**MESSAGE**

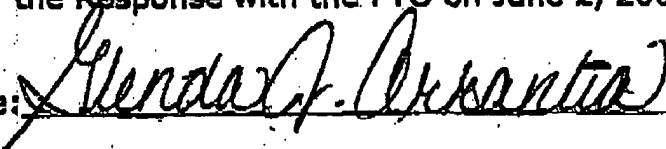
In re Application of: Mark D. Levedahl  
 Serial No.: 10/086,988  
 Filed: February 28, 2002  
 Group No.: 2121  
 Title: Method and System for Assigning Observations  
 Attorney Docket No.: 064749.0141

**PLEASE DELIVER IMMEDIATELY TO EXAMINER WILBERT STARK**

**Examiner Stark:**

Pursuant to your voice message, please find attached a true and correct copy of our Response Pursuant to 37 C.F.R. § 1.111, which was filed in connection with your Office Action mailed March 26, 2004. Also attached is a copy of our return postcard which acknowledges receipt of the Response with the PTO on June 2, 2004.

Signature:



Date: October 14, 2004

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<b>BAKER BOTTS LLP</b> <small>Our people will be in contact with you when required.</small>		2001 WES AVE DALLAS, TEXAS 75201-0900 214-953-6500 FAX 214-953-6503 www.bakerbotts.com		
FROM: Glenda Orrantia DATE: October 14, 2004 PAGES: 19		VOICE NO. 214-953-6559 FAX NO. 214-661-4559 RETURN TO Glenda Orrantia Legal Assistant		
TO: Examiner Wilbert L. Starks Art Unit 2131 U.S. Patent and Trademark Office		FAX NO. 703-872-9306 VOICE NO. 703-305-0027		
<b>MESSAGE</b> In re Application of: Mark D. Leveschik Serial No.: 10/006,388 Filed: February 28, 2002 Group No.: 2121 Title: Method and System for Assigning Observations Attorney Docket No.: 064748.0141				
<b>PLEASE DELIVER IMMEDIATELY TO EXAMINER WILBERT STARK</b>				
<b>Examiner Starks:</b> Pursuant to your voice message, please find attached a true and correct copy of our Response Pursuant to 37 C.F.R. § 1.111, which was filed in connection with your Office Action mailed March 26, 2004. Also attached is a copy of our return postcard which acknowledges receipt of the Response with the PTO on June 2, 2004.				
Signature: <u>Glenda J. Orrantia</u>		Date: October 14, 2004		
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064749.0141

PATENT APPLICATION  
10/086,988

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of: Mark D. Levedahl  
Serial No.: 10/086,988  
Filing Date: February 28, 2002  
Group Art Unit: 2121  
Examiner: Wilbert L. Starks  
Title: METHOD AND SYSTEM FOR ASSIGNING  
OBSERVATIONS

Mail Stop Amendment  
Commissioner for Patents  
PO Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

**CERTIFICATE OF MAILING BY EXPRESS MAIL**

I hereby certify that the attached Response Pursuant to 37 C.F.R. § 1.111 (16 pages), Baker Botts return postcard (1 postcard), and this Certificate of Mailing are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on this 2nd day of June 2004 and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

*Willie Jiles*  
\_\_\_\_\_  
Willie Jiles

Express Mail Receipt  
No. EV 324629669 US

ATTORNEY DOCKET NO.  
064749.0141

PATENT APPLICATION  
10/086,988

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of: Mark D. Levedahl  
Serial No.: 10/086,988  
Filing Date: February 28, 2002  
Group Art Unit: 2121  
Examiner: Wilbert L. Starks  
Title: METHOD AND SYSTEM FOR ASSIGNING  
OBSERVATIONS

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

**RESPONSE PURSUANT TO 37 C.F.R. § 1.111**

In response to the Office Action mailed March 26, 2004, Applicant respectfully requests the Examiner to reconsider the rejection of the claims in view of the following amendments and remarks. Please amend the Application as follows:

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064749.0141

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### IN THE CLAIMS

For the convenience of the Examiner, all pending claims of the present Application are shown below in numerical order whether or not an amendment has been made and applying the revised format guidelines of 37 C.F.R. 1.121.

1. (Currently Amended) A computerized method for assigning observations comprising:

receiving a plurality of first observations indicative of respective physical parameters positions observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters positions observed by a second sensor system;

assigning, by a computer, a set of pairs of the first and second observations predicted to correspond to the same physical parameter position, the assigning comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

2. (Original) The method of Claim 1, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

3. (Original) The method of Claim 1, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

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4. (Original) The method of Claim 1, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

5. (Previously Presented) The method of Claim 1, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^g \left\{ \begin{array}{ll} \delta x_i^T S_i^{-1} \delta x_i + \ln \|S_i\| - \ln(d_{\min}) & a(i) \neq 0 \\ \bar{g} & a(i) = 0 \end{array} \right\} + \left\{ \begin{array}{ll} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{array} \right\}$$

wherein  $J_i$  = Assignment score

$\bar{x}$  = Estimate of relative bias

$R$  = Relative registration covariance matrix

$\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$

$S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$

$d_{\min}$  = Minimum determinant of a residual error matrix

$g$  = Gate value

$M$  = Number of first observations

$n_a$  = Number of non-zero entries in  $a$

$a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$

$A_i$  = The plurality of first observations

$B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

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6. (Original) The method of Claim 5, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.

7. (Original) The method of Claim 5, wherein the relative bias,  $\bar{x}$ , of the cost function is a functional bias.

8. (Original) The method of Claim 1, wherein assigning, by a computer, comprises assigning by a processor operable to execute a computer program stored on a computer readable medium.

9. (Original) The method of Claim 1, wherein assigning, by a computer, comprises assigning by an application specific integrated circuit.

10. (Original) The method of Claim 1, wherein assigning, by a computer, comprises assigning by a digital signal processor.

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11. (Currently Amended) A computerized method for determining the Nbest observation assignments comprising:

receiving a plurality of first observations indicative of respective physical parameters positions observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters positions observed by a second sensor system;

determining, by a computer, one or more sets of pairs of the first and second observations predicted to correspond to the same physical parameter position, the determining comprising:

receiving a cost function that specifies a cost for each assigned pair;

determining a set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of corresponding first and second observations; and

repeating the determining act until a desired number of best observation assignments is determined.

12. (Original) The method of Claim 11, wherein the cost specified by the cost function for each assigned pair is not independent of the assignment of any other assigned pairs in the respective set of assigned pairs.

13. (Original) The method of Claim 11, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

14. (Original) The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

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15. (Original) The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

16. (Previously Presented) The method of Claim 11, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^M \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i + \ln \|S_i\| - \ln(d_{min})}{\bar{g}} \quad \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \left\{ \begin{matrix} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{matrix} \right\}$$

wherein  $J_i$  = Assignment score  
 $\bar{x}$  = Estimate of relative bias  
 $R$  = Relative registration covariance matrix  
 $\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$   
 $S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$   
 $d_{min}$  = Minimum determinant of a residual error matrix  
 $\bar{g}$  = Gate value  
 $M$  = Number of first observations  
 $n_a$  = Number of non-zero entries in  $a$   
 $a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$   
 $A_i$  = The plurality of first observations  
 $B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

17. (Original) The method of Claim 16, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.

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18. (Original) The method of Claim 16, wherein the relative bias,  $\bar{x}$ , of the cost function is a functional bias.
19. (Original) The method of Claim 11, wherein assigning, by a computer, comprises assigning by a processor operable to execute a computer program stored on a computer readable medium.
20. (Original) The method of Claim 11, wherein assigning, by a computer, comprises assigning by an application specific integrated circuit.
21. (Original) The method of Claim 11, wherein assigning, by a computer, comprises assigning by a digital signal processor.

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22. (Currently Amended) A system for assigning observations comprising: a computer readable medium; and

a computer program stored on the computer readable medium, the computer program operable, when executed on a processor, to:

receive a plurality of first observations indicative of respective physical parameters positions observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters positions observed by a second sensor system;

assign a set of pairs of the first and second observations predicted to correspond to the same physical parameter position, the assignment comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

23. (Original) The system of Claim 22, and further comprising a processor operable to execute the computer program.

24. (Original) The system of Claim 22, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

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25. (Original) The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

26. (Original) The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

27. (Previously Presented) The system of Claim 22, wherein the cost function is

$$J_i - \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^M \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i + \ln \|S_i\| - \ln(d_{\min})}{g} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \begin{cases} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_i$  = Assignment score

$\bar{x}$  = Estimate of relative bias

$R$  = Relative registration covariance matrix

$\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$

$S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$

$d_{\min}$  = Minimum determinant of a residual error matrix

$g$  = Gate value

$M$  = Number of first observations

$n_a$  = Number of non-zero entries in  $a$

$a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$

$A_i$  = The plurality of first observations

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$B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

28. (Original) The system of Claim 27, wherein the relative bias,  $x$ , of the cost function is a simple bias.

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29. (Currently Amended) A system for assigning observations comprising: a computer operable to receive a plurality of first observations indicative of respective physical ~~parameters~~ positions observed by a first sensor system and receiving a plurality of second observations indicative of respective physical ~~parameters~~ positions observed by a second sensor system; and

wherein the computer is further operable to assign a set of pairs of the first and second observations predicted to correspond to the same physical ~~parameter~~ position, the assignment comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

30. (Original) The system of Claim 29, wherein the computer comprising an application specific integrated circuit.

31. (Original) The system of Claim 29, wherein the computer comprises a processor operable to execute a computer program stored on the computer readable medium.

32. (Original). The system of Claim 29, wherein the computer further comprises the computer readable medium.

33. (Original). The system of Claim 29, wherein the computer comprises a digital signal processor.

34. (Original) The system of Claim 29, wherein the computer comprises a field programmable gate array.

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35. (Original) The system of Claim 29, wherein the computer comprises a means for computing.

36. (Original) The system of Claim 29, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

37. (Original) The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

38. (Original) The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

39. (Previously Presented) The system of Claim 26, wherein the cost function is

$$J_s = \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^I \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i + \ln \|S_i\| - \ln(d_{\min})}{\bar{g}} \quad \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \left\{ \begin{matrix} \ln \left( \frac{2\pi}{|R|} \right) & n_a = 0 \\ 0 & n_a > 0 \end{matrix} \right\}$$

wherein  $J_s$  = Assignment score  
 $\bar{x}$  = Estimate of relative bias

$R$  = Relative registration covariance matrix

$\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$

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$S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$

$d_{min}$  = Minimum determinant of a residual error matrix

$g$  = Gate value

$M$  = Number of first observations

$n_a$  = Number of non-zero entries in  $a$

$a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$

$A_i$  = The plurality of first observations

$B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

40. (Original) The system of Claim 39, wherein the relative bias,  $x$ , of the cost function is a simple bias.

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064749.0141

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### REMARKS

Applicant thanks the Examiner for conducting the telephone interview on June 1, 2004, and for the Examiner's thoughtful consideration of this case. During the telephone interview, Applicant and Examiner discussed the Examiner's rejection of Applicant's claims under 35 U.S.C. § 101. Specifically, Applicant and Examiner discussed alternative claim language, which is included among the claim amendments to Claims 1, 11, 22, and 29. No new matter has been introduced by these amendments. Applicant does not admit that these amendments were made as a result of any cited art. Applicant understands that all of the pending claims, as recited in this Response to Office Action, are patentable under 35 U.S.C. § 101. Applicant respectfully requests reconsideration and favorable action in this case.

### Rejections under 35 U.S.C. § 101

The Examiner rejects Claims 1-40 under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Specifically, the Examiner found that Applicant's "observation" references are abstract ideas. (Office Action, page 2). In the telephone interview conducted on June 1, 2004, Applicant and Examiner discussed the Examiner's rejection of Applicant's claims under § 101. Although Applicant believes that all previously pending claims recite statutory subject matter under § 101, to advance this case expeditiously to issuance, Applicant has amended independent Claims 1, 11, 22, and 29 to address the issues identified by the Examiner. For at least these reasons, Applicant understands that all of the pending claims, as recited in this Response to Office Action, recite statutory subject matter within the meaning of § 101.

Additionally, in the Office Action, the Examiner states that the "data referred to by Applicant's phrase 'information as natural language' is simply an abstract construct that does not limit the claims to the transformation of real world data (such as monetary data or heart rhythm data) by some disclosed process." (Office Action, page 6). In the telephone interview, the Examiner acknowledged that the phrase "information as natural language" is not recited in any of Applicant's pending claims and that the rejection of Applicant's claims as described in paragraph 14 of the Office Action was made in error. It is Applicant's understanding that the rejection of the claims described in paragraph 14 of the Office Action is withdrawn.

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064749.0141

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Applicant respectfully requests that the rejection of the Claims 1-40 under § 101 be withdrawn and the claims allowed.

**Rejections under 35 U.S.C. § 112**

The Examiner rejects Claims 1-40 under 35 U.S.C. § 112, first paragraph. Specifically, the Examiner states that "current case law (and accordingly, the MPEP) require such a rejection if a 101 rejection is given because . . . as a matter of law there is no way Applicant could have disclosed how to practice the *undisclosed* practical application." (Office Action, page 8). As discussed above, Applicant has amended independent Claims 1, 11, 22, and 29 to address the § 101 issues identified by the Examiner. Accordingly, the basis for the Examiner's § 112 rejection of Claims 1-40 has been removed. Furthermore, in the telephone interview conducted on June 1, 2004, the Examiner indicated that the pending claims, as recited in this Response to Office Action, are patentable under § 101 and § 112. For at least these reasons, Applicant respectfully requests that the rejection of the Claims 1-40 under § 112 be withdrawn and the claims allowed.

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064749.0141

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### CONCLUSION

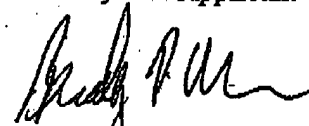
Applicant has made an earnest attempt to place this case in condition for allowance. For the foregoing reasons, and for other reasons clearly apparent, Applicant respectfully requests full allowance of all pending Claims.

If the Examiner feels that a telephone conference or an interview would advance prosecution of this Application in any manner, the undersigned attorney for Applicant stands ready to conduct such a conference at the convenience of the Examiner.

Applicant believes no fees are due. However, the Commissioner is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 02-0384 of Baker Botts L.L.P.

Respectfully submitted,

BAKER BOTTS L.L.P.  
Attorneys for Applicant



Bradley P. Williams  
Reg. No. 40,227

Date: June 2, 2004

Correspondence Address:  
2001 Ross Avenue, Suite 600  
Dallas, Texas 75201-2980  
(214) 953-6447

Customer No.

**05073**

Attorney's Docket No.  
064749.0141 (PD 02E002)

ATENT APPLICATION  
10/086,988

1

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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In re Application of:

Mark D. Levedahl

Serial No.:

10/086,988

Filing Date:

February 28, 2002

Title:

METHOD AND SYSTEM FOR ASSIGNING  
OBSERVATIONS

Confirmation No.:

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Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

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VA 22313-1450, on the date shown  
below.

*Elaine Barnes*  
Elaine Barnes

Date of Signature: June 6, 2003

Dear Sir:

REQUEST FOR STATUS

Please advise the status of the above-identified patent application. The application was filed on February 28, 2002. Applicant received the Filing Receipt on April 2, 2002. Applicant is currently awaiting a first Office Action.

Attorney's Docket No.  
064749.0141 (PD 02B002)

ATENT APPLICATION  
10/086,988

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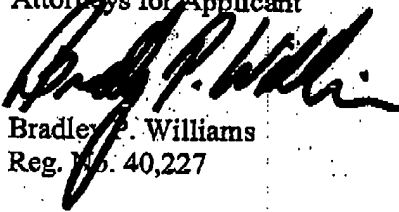
**REMARKS**

Under 37 C.F.R. § 1.702(a)(1), it has been over fourteen months since the filing date of this Application and a Notification under 35 U.S.C. § 132 has not been received. Thus, a period of adjustment of patent term due to examination delay is accruing in accordance with 37 C.F.R. § 1.703(a)(1).

If there are any matters that can be cleared up through a telephone conversation, please contact the undersigned attorney for Applicant at the telephone number listed below.

Respectfully submitted,

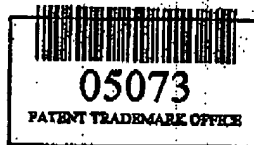
BAKER BOTTS L.L.P.  
Attorneys for Applicant

  
Bradley P. Williams  
Reg. No. 40,227

Date: June 5, 2003

2001 Ross Avenue, Suite 600  
Dallas, Texas 75201-2980  
Telephone No. (214) 953-6464

**CORRESPONDENCE ADDRESS:**  
Customer Number or Bar Code Label:



Attorney's Docket:  
064749.0141 (PD 02E002)

PATENT  
10/086,988

1

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of: Mark D. Levedahl  
Serial No.: 10/086,988  
Filing Date: February 28, 2002  
Title: METHOD AND SYSTEM FOR ASSIGNING  
OBSERVATIONS  
Confirmation No.: 6322

**BOX MISSING PARTS**

Assistant Commissioner  
for Patents  
Washington, D.C. 20231

Dear Sir:

**CERTIFICATE OF MAILING BY EXPRESS MAIL**

I hereby certify that the attached Response to Notice to File Missing Parts of Nonprovisional Application (2 pages), copy of Notice to File Missing Parts of Nonprovisional Application (1 page), a check in the amount of \$1,314.00, executed Declaration and Power of Attorney (3 pages), Assignment (2 pages), Assignment Cover Sheet (1 page), a check in the amount of \$40.00 for the Assignment recordal fee, a Preliminary Amendment (32 pages), this Certificate of Mailing by Express Mail, and an acknowledgment postcard are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on this 28th day of June, 2002 addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

*Willie Jiles*  
Willie Jiles

Express Mail Receipt  
No. EL 953699120 US

Attorney's Docket: 064749.0141 (PD 02E002).

PATENT  
10/086,988

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Mark D. Levedahl  
Serial No.: 10/086,988  
Filing Date: February 28, 2002  
Group Art Unit: 6322  
Title: METHOD AND SYSTEM FOR ASSIGNING  
OBSERVATIONS

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## NOTIFICATION OF EXTENSION OF TIME UNDER 37 C.F.R. § 1.136

Honorable Assistant Commissioner  
for Patents  
Washington, D.C. 20231

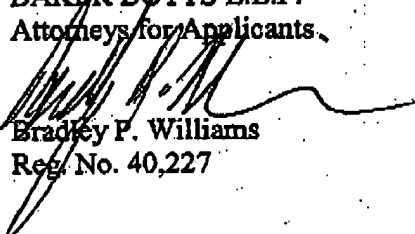
Dear Sir:

Applicants hereby take an Extension of Time for responding to the Office Action dated April 2, 2002 for one (1) month from June 2, 2002 to July 2, 2002.

☒ First Month \$110.00  
☐ Second Month  
☐ Third Month  
☐ Fourth Month

A check in the amount of \$110.00 is enclosed to cover the fee. The Commissioner is hereby authorized to charge any other fees or to credit any overpayments to Deposit Account No. 02-0384 of Baker Botts L.L.P.

Respectfully submitted,

BAKER BOTTS L.L.P.  
Attorneys for Applicants.  
Bradley P. Williams  
Reg. No. 40,227

2001 Ross Avenue, Suite 600  
Dallas, Texas 75201-2980

(214) 953-6447

Date: June 28, 2002

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PATENT APPLICATION  
10/033,080

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(b) A completed Declaration and Power of Attorney for the above-referenced patent application, which was filed February 28, 2002.

(c) A completed Assignment for the above-referenced patent application. The filing fee in the amount of \$40.00 is included herewith.

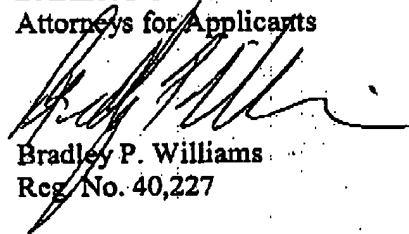
(d) A check in the amount of \$1,314.00 is enclosed for filing fees, additional claims charge and surcharge for a large entity.

(e) Notification of Extension of Time and check in the amount of \$110.00.

The Commissioner is hereby authorized to charge any amount required or credit any overpayment to Deposit Account No. 02-0384 of BAKER BOTTS L.L.P.

Respectfully submitted,

BAKER BOTTS L.L.P.  
Attorneys for Applicants



Bradley P. Williams  
Reg. No. 40,227

Date: June 20, 2002

Correspondence Address:

BAKER BOTTS L.L.P.  
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DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD AND SYSTEM FOR ASSIGNING OBSERVATIONS, the specification of which was filed on February 28, 2002 as Application Serial No. 10/086,988.

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above; and

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in 37 C.F.R. § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Number	Country	Date Filed	Priority Claimed (Yes) (No)
-----NONE-----			

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

<u>Application Serial Number</u>	<u>Date Filed</u>	<u>Status</u>
-----NONE-----		

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application(s) in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

<u>Application Serial Number</u>	<u>Date Filed</u>	<u>Status (Patented, Pending, Abandoned)</u>
-----NONE-----		

I hereby appoint the following as my attorneys/agents with full power of substitution and revocation, to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith, and to file and prosecute any international patent applications filed thereon before any international authorities:

René E. Grossman	Reg. No. 22,656
Glenn H. Lenzen, Jr.	Reg. No. 29,320
Philip P. Berestecki	Reg. No. 26,502
William C. Schubert	Reg. No. 30,102
Leonard A. Alkov	Reg. No. 30,021
Colin M. Raufer	Reg. No. 40,781
Robin R. Loporchio	Reg. No. 40,071
David L. Kinsinger	Reg. No. 33,927
John J. Snyder	Reg. No. 39,380

all of Raytheon Company; and

The practitioners at Customer Number



all of the firm of Baker Botts L.L.P.

Send Correspondence To:  
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2001 Ross Avenue, Suite 600  
Dallas, Texas 75201-2980

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Bradley P. Williams  
at (214) 953-6447  
Atty. Docket No. 064749.0141

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USSN: 10/086,988

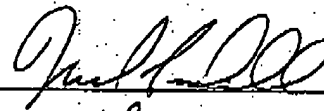
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full name of the sole or first inventor

Mark D. Levedahl

Inventor's signature



Date

23 Jan 02

Residence (City, County, State)

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## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Levedahl, Mark D.  
Title: Method and System for Assigning  
Observations  
Serial No.: 10/086,988  
Filing Date: February 28, 2002  
Confirmation No.: 6322

## BOX: NON-FEE AMENDMENT

Assistant Commissioner for  
Patents  
Washington, D.C. 20231

Dear Sir:

"EXPRESS MAIL"			
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Date of Deposit: June __, 2002			
I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.			
<i>Willie Jiles</i>			
Willie Jiles			

PRELIMINARY AMENDMENT

Prior to the initial review of this patent application entitled Method and System for Assigning Observations by Mark C. Levedahl, please amend the application as follows:

IN THE SPECIFICATION

The specification is amended as follows. Please refer to the attached sheets showing a marked-up version of the amendments to the specification.

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On Page 14, please replace the paragraphs beginning on Lines 17 and 27 with:

After the governing equations are formulated at step 40 a cost function is assigned at step 42. Assuming that all items in A are assigned and following standard approaches for track-to-track association, the Gaussian probability density for a given assignment set is given by:

$$P_a = \frac{e^{-\bar{x}^T R^{-1} \bar{x}/2}}{(2\pi)^{M/2} \sqrt{|R|}} \prod_i \frac{e^{-[A_i - B_{a(i)} - \bar{x}]^T (P_i + Q_{a(i)})^{-1} [A_i - B_{a(i)} - \bar{x}]/2}}{(2\pi)^{M/2} \sqrt{|P_i + Q_{a(i)}|}} \quad (6)$$

where  $\bar{x}$  is an estimate of the relative bias  $\bar{x}_a - \bar{x}_b$ . A term referred to as an assignment gate is utilized to account for unassigned elements in a and taking the negative logarithm of both sides and multiplying by Equation 2 yields the hypothesis score ( $J_a$ ) to be maximized through choice of a:

$$\begin{aligned} \delta x_i &= A_i - B_{a(i)} - \bar{x} \\ S_i &= P_i + Q_{a(i)} \\ J_a &= -\bar{x}^T R^{-1} \bar{x} - \ln[(2\pi)^M |R|] - \sum_{i=1}^n \left\{ \delta x_i^T S_i^{-1} \delta x_i + \ln[S_i] \right\} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \end{aligned} \quad (7)$$

Equation 7 assumes at least one assignment in a, and the value g, which used in deciding to accept a given assignment: g includes the missing  $\ln(2n)$  term and is described in greater detail below. The bias estimate, x, is chosen to maximize the assignment score, represented by  $J_a$ . The value for this is determined by taking the partial derivative of equation 7 with respect to x, setting the result to zero, and solving, resulting in:

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$$\bar{x} = \left( \sum_{i=1}^n \begin{bmatrix} A_i - B_{a(i)} & P_i + Q_{a(i)} \\ 0 & a(i) \neq 0 \end{bmatrix} \right) \left( R^{-1} + \sum_{i=1}^n [P_i + Q_{a(i)}] \right)^{-1} \quad (8)$$

Again, the bias is computed based upon the assigned elements only. With no assignments made, the bias is indeterminate. Equations 7 and 8 utilize a simple bias, but could be easily reformulated with a functional bias, such as a hyperbolic displacement as a function of relative position. Other types of bias that may be accounted for include scale factor errors and rotation errors. Equations 7 and 8 together define the assignment score function that a GNP assignment algorithm must maximize. A simplification is available in the special case of homogeneous error variances (e.g., all  $P_i = P$  and all  $Q_j = Q$ .) In this case, equation 8 becomes:

$$\bar{x}_n = [n_p f_n + (P+Q)R^{-1}]^{-1} \sum_{i=1}^n \begin{bmatrix} A_i - B_{a(i)} & a(i) \neq 0 \\ 0 & a(i) = 0 \end{bmatrix} \quad (9)$$

$n_p$  : number of non-zero entries in  $a$

It is noteworthy that the costs in equation 7 do not support generation of a cost matrix as in the classic GNN problem. Rather, the cost of any particular assignment  $a(i)=j$  is dependent upon the bias estimate and hence upon the entire assignment hypothesis. The entire assignment hypothesis refers to a hypothesized set of all assignments. The integer programming methods used to solve the GNN problem are based upon independent costs for each assignment and hence incapable of handling the GNP problem. This is a feature of the GNP problem that utilizes the teachings of a new invention for solution.

An "equivalent" cost function for the GNN problem is defined here. This can be a rough equivalent only, as

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the bias is ignored (the assumption being that the bias is zero). The GNN formulation is in fact found by removing the bias related terms from equation 7, with result in:

$$J_{gna} = - \sum_{i=1}^n \left\{ \begin{array}{ll} [A_i - B_{a(i)}]^T S_i^{-1} [A_i - B_{a(i)}] + \ln[S_i] & a(i) \neq 0 \\ g & a(i) = 0 \end{array} \right\} \quad (10)$$

In general, the residual covariance  $S_i$  in equation 10 would be inflated to account for residual bias errors.

After assignment of a cost function at step 42, gating is accounted for at step 44. Gating refers to accounting for non-assignment of an observation, such as observation 22 to an observation in second system 14. For any potential assignment  $a(i) = j$ , there are two hypotheses:

- $H_0$ :  $A_i$  and  $B_j$  represent independent observations and  $a(i) = j$  should be rejected in favor of  $a(i) = 0$ .  
 $H_1$ :  $A_i$  and  $B_j$  represent the same object and  $a(i) = j$  should be accepted.

The gate value  $g$  is used in the above test. Given the interdependence of all assignments in a hypothesis, a cost cannot be uniquely defined for any particular assignment. The gating approach presented here treats the change in score when an assignment is added to a set as the cost of that assignment, and hence the value tested against  $g$  to choose  $H_0$  or  $H_1$ .

In the case where system A sends its full set of observations, the standard maximum likelihood gate used for the GNN problem is applicable but needs adjustment to allow for the extra term in equation 7 related to the

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bias. Given true target density over the surveillance volume  $\beta$ , false target densities for systems A and B are  $\beta_{FTA}$  and  $\beta_{FTB}$ , and probabilities for A and B of observing a target are  $P_{TA}$  and  $P_{TB}$ , the maximum likelihood gate value is (Blackman<sup>2</sup>, equation 9.15):

$$g = 2 \ln \left[ \frac{\beta_i P_{TA} P_{TB}}{(2\pi)^{M/2} P_{NTA} P_{NTB}} \right]$$

$$P_{NTA} = \beta_i P_{TB} (1 - P_{TA}) + \beta_{FTB}$$

$$P_{NTB} = \beta_i P_{TA} (1 - P_{TB}) + \beta_{FTA}$$
(11)

The GNP formulation is especially useful for a one-time object map handover. Typically, an object map has an a priori defined maximum number of elements, regardless of the true number of tracks present in the source. This corresponds to a lower  $P_{TA}$  and thus indicates a smaller gate value may be required than is given by equation 11.

There are  $m+1$  terms summed to give an assignment score in equation 7 as opposed to  $m$  terms in the GNN formulation of equation 10. The extra term is due to the bias error, and as the first assignment added to a hypothesis is primarily responsible for determining the bias, the solution approach here uses  $2g$  as the gating value for the first assignment. The direct impact of this decision is that entire hypotheses are less likely to be gated out given a large bias: gating out a single assignment that is marginal is acceptable, but gating out an entire hypothesis due to a large bias may not be acceptable.

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After gating is accounted for at step 44, feature data may be used at step 46. The cost function given in equation 7 explicitly assumes that biases exist between the two systems in all dimensions of the common frame of reference. However, the formulation is easily expanded to include additional feature data and/or observations where the residual bias is unimportant (e.g., vehicle velocity). Assuming the feature observations are in arrays  $A^f$  and  $B^f$  with residual covariance  $F_{ij}$ , the hypothesis score becomes:

$$\delta f_i^2 = [A_i^f - B_{a(i)}^f]^T (F_{i,a(i)})^{-1} [A_i^f - B_{a(i)}^f] + \ln(F_{i,a(i)})$$

$$J_{af} = -\bar{x}^T R^{-1} \bar{x} - \ln[(2\pi)^N |R|] - \sum_{i=1}^n \left\{ \begin{array}{ll} \delta x_i^T S_i^{-1} \delta x_i + \ln|S_i| & a(i) \neq 0 \\ g & a(i) = 0 \end{array} \right\} + \delta f_i^2 \quad (12)$$

The score for a hypothesis at stage  $s$ ,  $s$  is the number of assignment decisions made, with  $n_a$  ( $n_a > 0$ ) assignments is:

$$J_s = -\bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^i \left\{ \begin{array}{ll} \delta x_i^T S_i^{-1} \delta x_i + \ln|S_i| - \ln(d_{min}) & a(i) \neq 0 \\ g & a(i) = 0 \end{array} \right\} + \left\{ \begin{array}{ll} \ln[(2\pi)^N |R|] & n_a = 0 \\ 0 & n_a > 0 \end{array} \right\} \quad (17)$$

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**IN THE CLAIMS**

1. A computerized method for assigning observations comprising:

receiving a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters observed by a second sensor system;

assigning, by a computer, a set of pairs of the first and second observations predicted to correspond to the same physical parameter, the assigning comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

2. The method of Claim 1, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision,

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wherein the plurality of nodes are grouped in a plurality of stages.

3. The method of Claim 1, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

4. The method of Claim 1, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

5. The method of Claim 1, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^I \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i + \ln \|S_i\|}{g} - \ln(d_{\min}) \right\} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} + \begin{cases} \ln \left( (2\pi)^M |R| \right) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_i$  = Assignment score

$\bar{x}$  = Estimate of relative bias

$R$  = Relative registration covariance matrix

$\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$

$S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$

$d_{\min}$  = Minimum determinant of a residual error matrix

$g$  = Gate value

$M$  = Number of first observations

$n_a$  = Number of non-zero entries in a

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$a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$

$A_i$  = The plurality of first observations

$B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

6. The method of Claim 5, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.

7. The method of Claim 5, wherein the relative bias,  $\bar{x}$ , of the cost function is a functional bias.

8. The method of Claim 1, wherein assigning, by a computer, comprises assigning by a processor operable to execute a computer program stored on a computer readable medium.

9. The method of Claim 1, wherein assigning, by a computer, comprises assigning by an application specific integrated circuit.

10. The method of Claim 1, wherein assigning, by a computer, comprises assigning by a digital signal processor.

11. A computerized method for determining the Nbest observation assignments comprising:

receiving a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations

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indicative of respective physical parameters observed by a second sensor system;

determining, by a computer, one or more sets of pairs of the first and second observations predicted to correspond to the same physical parameter, the determining comprising:

receiving a cost function that specifies a cost for each assigned pair;

determining a set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of corresponding first and second observations; and

repeating the determining act until a desired number of best observation assignments is determined.

12. The method of Claim 11, wherein the cost specified by the cost function for each assigned pair is not independent of the assignment of any other assigned pairs in the respective set of assigned pairs.

13. The method of Claim 11, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment

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decision, wherein the plurality of nodes are grouped in a plurality of stages.

14. The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

15. The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

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16. The method of Claim 11, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^I \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i + \ln[S_i]}{\bar{g}} - \ln(d_{min}) \quad \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \left\{ \begin{matrix} \ln([2\pi]^M |R|) & n_a \approx 0 \\ 0 & n_a > 0 \end{matrix} \right\}$$

wherein  $J_i$  = Assignment score  
 $\bar{x}$  = Estimate of relative bias  
 $R$  = Relative registration covariance matrix  
 $\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$   
 $S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$   
 $d_{min}$  = Minimum determinant of a residual error matrix  
 $g$  = Gate value  
 $M$  = Number of first observations  
 $n_a$  = Number of non-zero entries in  $a$   
 $a$  = Assignment vector:  $a(i) > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$   
 $A_i$  = The plurality of first observations  
 $B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

17. The method of Claim 16, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.

18. The method of Claim 16, wherein the relative bias,  $\bar{x}$ , of the cost function is a functional bias.

19. The method of Claim 11, wherein assigning, by a computer, comprises assigning by a processor operable to execute a computer program stored on a computer readable medium.

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20. The method of Claim 11, wherein assigning, by a computer, comprises assigning by an application specific integrated circuit.

21. The method of Claim 11, wherein assigning, by a computer, comprises assigning by a digital signal processor.

22. A system for assigning observations comprising: a computer readable medium; and

a computer program stored on the computer readable medium, the computer program operable, when executed on a processor, to:

receive a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters observed by a second sensor system;

assign a set of pairs of the first and second observations predicted to correspond to the same physical parameter, the assignment comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph

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representative of possible assignments of first and second observations.

23. The system of Claim 22, and further comprising a processor operable to execute the computer program.

24. The system of Claim 22, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

25. The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

26. The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

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27. The system of Claim 22, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x} - \sum_{l=1}^i \left\{ \frac{\delta x_l^T S_l^{-1} \delta x_l + \ln \|S_l\| - \ln(d_{\min})}{\bar{g}} \quad \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \begin{cases} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_i$  = Assignment score  
 $\bar{x}$  = Estimate of relative bias  
 $R$  = Relative registration covariance matrix  
 $\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$   
 $S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$   
 $d_{\min}$  = Minimum determinant of a residual error matrix  
 $g$  = Gate value  
 $M$  = Number of first observations  
 $n_a$  = Number of non-zero entries in  $a$   
 $a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$   
 $A_i$  = The plurality of first observations  
 $B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

28. The system of Claim 27, wherein the relative bias,  $x$ , of the cost function is a simple bias.

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29. A system for assigning observations comprising: a computer operable to receive a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters observed by a second sensor system; and

wherein the computer is further operable to assign a set of pairs of the first and second observations predicted to correspond to the same physical parameter, the assignment comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

30. The system of Claim 29, wherein the computer comprising an application specific integrated circuit.

31. The system of Claim 29, wherein the computer comprises a processor operable to execute a computer program stored on the computer readable medium.

32. The system of Claim 29, wherein the computer further comprises the computer readable medium.

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33. The system of Claim 29, wherein the computer comprises a digital signal processor.

34. The system of Claim 29, wherein the computer comprises a field programmable gate array.

35. The system of Claim 29, wherein the computer comprises a means for computing.

36. The system of Claim 29, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis; the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

37. The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

38. The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second

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observations comprises calculating the optimal value by a Dijkstra algorithm.

39. The system of Claim 26, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^I \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i + \ln \|S_i\| - \ln(d_{\min})}{\bar{g}} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \begin{cases} \ln \left( \frac{2\pi}{|R|} \right) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_i$  = Assignment score  
 $\bar{x}$  = Estimate of relative bias  
 $R$  = Relative registration covariance matrix  
 $\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$   
 $S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$   
 $d_{\min}$  = Minimum determinant of a residual error matrix  
 $\bar{g}$  = Gate value  
 $M$  = Number of first observations  
 $n_a$  = Number of non-zero entries in  $a$   
 $a$  = Assignment vector:  $a(i) > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$   
 $A_i$  = The plurality of first observations  
 $B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

40. The system of Claim 39, wherein the relative bias,  $x$ , of the cost function is a simple bias.

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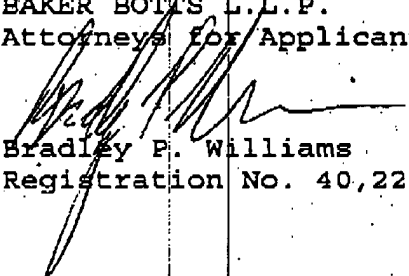
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REMARKS

Early and favorable acceptance of this application is respectfully requested. No fees are believed due; however, the Commissioner is authorized to charge any additional fees required by this paper to Deposit Account No. 02-0384 of BAKER BOTTS L.L.P.

Respectfully submitted,

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**MARKED UP VERSION OF SPECIFICATION AND CLAIMS**  
**IN THE SPECIFICATION**

Page 2, Equation 6, please amend as follows:

$$P_a = \frac{e^{-\bar{x}^T R^{-1} \bar{x} / 2}}{(2\pi)^{M/2} \sqrt{|R|}} \prod_i \frac{e^{-[A_i - B_{a(i)} - \bar{x}]^T (P_i + Q_{a(i)})^{-1} [A_i - B_{a(i)} - \bar{x}] / 2}}{(2\pi)^{M/2} \sqrt{|P_i + Q_{a(i)}|}} \quad (6)$$

Page 2, Equation 7, please amend as follows:

$$\begin{aligned} \delta x_i &= A_i - B_{a(i)} - \bar{x} \\ S_i &= P_i + Q_{a(i)} \\ J_a &= -\bar{x}^T R^{-1} \bar{x} - \ln[(2\pi)^M |R|] - \sum_{i=1}^n \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i}{g} + \ln[S_i] \right\} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \end{aligned} \quad (7)$$

Page 4, Equation 10, please amend as follows:

$$J_{gmn} = -\sum_{i=1}^n \left\{ \frac{[A_i - B_{a(i)}]^T S_i^{-1} [A_i - B_{a(i)}]}{g} + \ln[S_i] \right\} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \quad (10)$$

Page 6, Equation 12, please amend as follows:

$$\begin{aligned} \delta f_i^2 &= [A_i^f - B_{a(i)}^f]^T (F_{i,a(i)})^{-1} [A_i^f - B_{a(i)}^f] + \ln(F_{i,a(i)}) \\ J_{af} &= -\bar{x}^T R^{-1} \bar{x} - \ln[(2\pi)^M |R|] - \sum_{i=1}^n \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i}{g} + \ln[S_i] \right\} + \delta f_i^2 \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \end{aligned} \quad (12)$$

Pages 6, Equation 17, please amend as follows:

$$J_f = -\bar{x}^T R^{-1} \bar{x} - \sum_{i=1}^n \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i}{g} + \ln[S_i] - \ln(d_{\min}) \right\} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} + \begin{cases} \ln[(2\pi)^M |R|] & n_a = 0 \\ 0 & n_a > 0 \end{cases} \quad (17)$$

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### IN THE CLAIMS

1. A computerized method for assigning observations comprising:

receiving a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters observed by a second sensor system;

assigning, by a computer, a set of pairs of the first and second observations predicted to correspond to the same physical parameter, the assigning comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

2. The method of Claim 1, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision,

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wherein the plurality of nodes are grouped in a plurality of stages.

3. The method of Claim 1, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

4. The method of Claim 1, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

5. (Amended) The method of Claim 1, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x}^M - \sum_{i=1}^M \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i^M + \ln[S_i]}{\bar{g}} - \ln(d_{min}) \right\} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} + \begin{cases} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_i$  = Assignment score  
 $\bar{x}$  = Estimate of relative bias  
 $R$  = Relative registration covariance matrix  
 $\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$   
 $S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$   
 $d_{min}$  = Minimum determinant of a residual error matrix  
 $g$  = Gate value  
 $M$  = Number of first observations  
 $n_a$  = Number of non-zero entries in a

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$a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$

$A_i$  = The plurality of first observations

$B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

6. The method of Claim 5, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.

7. The method of Claim 5, wherein the relative bias,  $\bar{x}$ , of the cost function is a functional bias.

8. The method of Claim 1, wherein assigning, by a computer, comprises assigning by a processor operable to execute a computer program stored on a computer readable medium.

9. The method of Claim 1, wherein assigning, by a computer, comprises assigning by an application specific integrated circuit.

10. The method of Claim 1, wherein assigning, by a computer, comprises assigning by a digital signal processor.

11. A computerized method for determining the N-best observation assignments comprising:

receiving a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations.

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indicative of respective physical parameters observed by a second sensor system;

determining, by a computer, one or more sets of pairs of the first and second observations predicted to correspond to the same physical parameter, the determining comprising:

receiving a cost function that specifies a cost for each assigned pair;

determining a set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of corresponding first and second observations; and

repeating the determining act until a desired number of best observation assignments is determined.

12. The method of Claim 11, wherein the cost specified by the cost function for each assigned pair is not independent of the assignment of any other assigned pairs in the respective set of assigned pairs.

13. The method of Claim 11, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment

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decision, wherein the plurality of nodes are grouped in a plurality of stages.

14. The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

15. The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

16. (Amended) The method of Claim 11, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x}^{(M)} - \sum_{i=1}^M \left\{ \frac{\bar{x}_i^T S_i^{-1} \bar{x}_i^{(M)} + \ln \|S_i\| - \ln(d_{\min})}{g} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \begin{cases} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_i$  = Assignment score

$\bar{x}$  = Estimate of relative bias

$R$  = Relative registration covariance matrix

$\bar{x}_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$

$S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$

$d_{\min}$  = Minimum determinant of a residual error matrix

$g$  = Gate value

$M$  = Number of first observations

$n_a$  = Number of non-zero entries in a

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$a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$

$A_i$  = The plurality of first observations

$B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

17. The method of Claim 16, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.

18. The method of Claim 16, wherein the relative bias,  $\bar{x}$ , of the cost function is a functional bias.

19. The method of Claim 11, wherein assigning, by a computer, comprises assigning by a processor operable to execute a computer program stored on a computer readable medium.

20. The method of Claim 11, wherein assigning, by a computer, comprises assigning by an application specific integrated circuit.

21. The method of Claim 11, wherein assigning, by a computer, comprises assigning by a digital signal processor.

22. A system for assigning observations comprising: a computer readable medium; and

a computer program stored on the computer readable medium, the computer program operable, when executed on a processor, to:

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receive a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters observed by a second sensor system;

assign a set of pairs of the first and second observations predicted to correspond to the same physical parameter, the assignment comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

23. The system of Claim 22, and further comprising a processor operable to execute the computer program.

24. The system of Claim 22, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score

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resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

25. The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

26. The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

27. (Amended). The system of Claim 22, wherein the cost function is

$$J_i = \bar{x}^T R^{-1} \bar{x}^m - \sum_{i=1}^M \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i^m + \ln \|S_i\| - \ln(d_{min})}{\bar{g}} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} \right\} + \begin{cases} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein

- $J_i$  = Assignment score
- $\bar{x}$  = Estimate of relative bias
- $R$  = Relative registration covariance matrix
- $\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$
- $S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$
- $d_{min}$  = Minimum determinant of a residual error matrix
- $\bar{g}$  = Gate value
- $M$  = Number of first observations
- $n_a$  = Number of non-zero entries in  $a$

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$a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$   
 $A_i$  = The plurality of first observations  
 $B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

28. The system of Claim 27, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.

29. A system for assigning observations comprising: a computer operable to receive a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters observed by a second sensor system; and

wherein the computer is further operable to assign a set of pairs of the first and second observations predicted to correspond to the same physical parameter, the assignment comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

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30. The system of Claim 29, wherein the computer comprising an application specific integrated circuit.

31. The system of Claim 29, wherein the computer comprises a processor operable to execute a computer program stored on the computer readable medium.

32. The system of Claim 29, wherein the computer further comprises the computer readable medium.

33. The system of Claim 29, wherein the computer comprises a digital signal processor.

34. The system of Claim 29, wherein the computer comprises a field programmable gate array.

35. The system of Claim 29, wherein the computer comprises a means for computing.

36. The system of Claim 29, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

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37. The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a network shortest path algorithm.

38. The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

39. (Amended) The system of Claim 26, wherein the cost function is

$$J_i - \bar{x}^T R^{-1} \bar{x}^{(T)} - \sum_{i=1}^I \left\{ \frac{\delta x_i^T S_i^{-1} \delta x_i^{(T)} + \ln[S_i]}{g} - \ln(d_{\min}) \right\} \begin{matrix} a(i) \neq 0 \\ a(i) = 0 \end{matrix} + \begin{cases} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{cases}$$

wherein  $J_i$  = Assignment score  
 $\bar{x}$  = Estimate of relative bias  
 $R$  = Relative registration covariance matrix  
 $\delta x_i$  = State vector difference =  $A_i - B_{a(i)} - \bar{x}$   
 $S_i$  = Residual error covariance for pair  $A_i$  and  $B_{a(i)}$   
 $d_{\min}$  = Minimum determinant of a residual error matrix  
 $g$  = Gate value  
 $M$  = Number of first observations  
 $n_a$  = Number of non-zero entries in  $a$   
 $a$  = Assignment vector:  $a_{(i)} > 0 \rightarrow A_i$  is assigned to  $B_{a(i)}$   
 $A_i$  = The plurality of first observations  
 $B_{a(i)}$  = The plurality of second observations assigned to  $A_i$

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40. The system of Claim 39, wherein the relative bias,  $\bar{x}$ , of the cost function is a simple bias.

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